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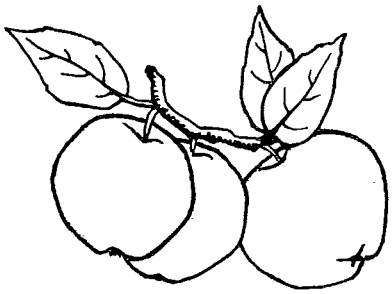

In 1954 Tasmania processed 1·32 million bushels of apples out of a total crop of 5·3 million bushels.

CANNING APPLE

BETWEEN 1944 AND 1954 OFFICERS OF THE Division of Food Preservation and Transport made observations on the canning of apples in Tasmanian canneries and carried out a number of experiments on canning techniques with a view to improving the quality of the product. The present article discusses the canning of solid-pack apple, which is the most important economically, as well as apple pulp and sliced apple in syrup.

RAW MATERIAL

It is generally considered that Sturmer is the best canning variety but Cox, Cleopatra, Crofton, Geeveston Fanny, Duke of Clarence, Jonathan, Granny Smith, Stone Pippin, Statesman, and Rome Beauty apples are satisfactory if they are not overmature.

Democrat, Scarlet Alfriston, French Crab, and the Delicious varieties are rated poorly by the industry, but with the improved processing methods now in use these varieties can give satisfactory results.

Generally the fresh fruit market absorbs the bulk of the first-quality fruit and canneries are forced to process some undersized fruit and some less suitable varieties. However, in seasons when the skin disease black spot is prevalent, fruit supplies to canneries improve because the fruit is then less acceptable to the fresh fruit market.

Because the fruit picking season is short compared with the canning season, canneries store large quantities of fruit. Common storage is often employed but leads to faster quality deterioration than storage under controlled conditions. The best results are obtained by storing the fruit at 34° F in clean, dry boxes.

Since the variety and maturity of the raw material affect the quality of the final product, processors endeavour to separate batches of different variety and maturity during both storage and subsequent processing.

SOLID-PACK APPLE

Current techniques for processing solid-pack apple are summarized below and some improvements are suggested.

Peeling and Coring

The most commonly used peeling and coring machine is the Smith and Searls type. Although other types are used, this machine is probably the most efficient in use at present. Improved yields may be obtained from these machines by size-grading the apples before peeling, but this is not a common practice.

Seed Celling

The seed celling machine is designed to remove any remaining seed and core tissue from peeled and cored apples. At present this operation is not common in the industry, so that much of the canned apple contains hard pieces of core tissue which diminish its acceptability to consumers.

Trimming

Trimming is done by hand. The number of trimmers employed (up to about four per peeling machine) varies with the quality of fruit. To avoid delay and consequent tissue discoloration, the trimming operation must keep pace with peeling and coring. At the suggestion of C.S.I.R.O., some plants now hold the peeled apples in brine tanks until they are trimmed; this technique effectively prevents discoloration.

Conveying

After being trimmed, the fruit is commonly conveyed to the cutting machine on rubber conveyor belts designed to move the fruit quickly enough to prevent tissue discoloration. Alternatively, brine flumes may be used for conveying the fruit.

Cutting

Three types of machine are used to cut the trimmed apple into smaller units.

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PRODUCTS IN TASMANIA

Grid Dicer.—This machine was widely used until it was replaced recently by the chipper and "mandarin" slicer. The dicer consists of a plate which forces the apple, without orientation, through a grid of knives spaced 1 in. by $\frac{3}{4}$ in. The machine has a large capacity but cuts the apple into pieces of irregular size and shape. To avoid over-blanching small pieces of apple, processors sometimes under-blanched the large pieces, thus setting up conditions favourable for internal rusting of the cans. In addition, variation in size and shape of the diced apple and consequent variation in the effectiveness of blanching resulted in poor appearance and uneven texture in the canned product.

Chipper.—Recently many canneries have replaced dicing machines with chipping machines, which cut to a more uniform size although the apple is again not orientated. Chipped apple blanches more evenly and has a better appearance than apple cut in the dicer.

An Urschel-type dicer can be converted into a satisfactory chipping machine by removing the cross-cut knives. A chip size of $\frac{3}{8}$ in. by $\frac{3}{8}$-$\frac{1}{2}$ in. is commonly used.

"*Mandarin*" *Type Slicer.*—This machine is used to slice apples for choice quality solid pack and syrup pack. The apple is orientated by a metal spike through the core hole and then forced through radial blades.

Holding Tank

After being cut, the apple falls into a holding tank which contains a 1-2 per cent. salt solution. This tank serves several purposes:

- It is a means of ensuring a uniform supply of peeled apple to the subsequent canning operations, which require a steady flow of apple.
- Apple submerged in the brine can be held during short stoppages without developing a brown discoloration.
- In the holding tank most of the remaining seeds, core fragments, and chaff separate from the apple. This unwanted material tends to sink to the bottom of the tank while the apple floats. The separation can be aided by fitting the tank with a perforated false bottom.
- It is generally accepted that the small quantity of salt taken up by the apple enhances its flavour. Salt must be added to the solution at intervals during a shift to maintain its original concentration.
- Like tomatoes, apple tissue may be firmed by soaking in dilute solutions of calcium chloride. A convenient way to apply this firming treatment is by adding the calcium chloride to the brine in the holding tank.

C.S.I.R.O. investigations showed that the firmness imparted depends on the fruit variety and maturity, the temperature and period of immersion, and the concentration of the solution. Although it is impossible to specify conditions which give the best results in all cases, a treatment in 0·01-0·05 per cent. calcium chloride solution for five minutes at room temperature usually gives satisfactory firmness. Investigations also showed that excessive exposure to calcium chloride imparts an off-flavour to the apple and causes objectionable toughening in texture. At present the calcium firming of canned apple is not approved by public health authorities.

Overseas work has demonstrated and C.S.I.R.O. investigations have confirmed that removal of oxygen from apple tissues greatly extends the shelf life of the canned product. Oxygen may be removed from the fruit

tissue by holding it submerged in warm brine. Aerobic respiratory processes are accelerated and the entrapped oxygen is consumed. A holding period of 20 minutes in a bath at 110-120 °F is usually adequate. Longer holding periods may discolour the fruit and cause excessive salt uptake.

Elevator

The apple is moved from the holding tank to the blancher either manually or by a mechanized elevator. Employment of labour for this operation is preferred by some canneries because the apple in the holding tank can be properly circulated and submerged by the operator and the supply of apple to the blancher may be kept constant.

Blanching

In the blancher the apple receives a steam treatment which is designed to:

- Inactivate fruit enzymes and so prevent discoloration.
- Remove gas from the tissue to minimize can corrosion.
- Soften the tissue to allow the fill-in weight to be easily reached.
- Ensure that the tissue is hot enough to attain commercial sterility when packed in the can.

The conditions of time and temperature to satisfy these requirements vary with the raw material. Blanching times from 2½ to 6 minutes at 200-210 °F are used in the industry and usually give satisfactory canned products.

The blancher consists of an enclosed steam box which slopes upwards from the entry chute to the discharge chute. The apple is carried through this box on an endless belt of monel-metal mesh. The depth of apple (2-4 in.) is controlled by a movable plate at the entrance chute. Usually steam distribution pipes are situated under the mesh belt and the steam supply is manually controlled by reference to temperatures recorded on thermometers in the roof of the blancher. In most blanchers two banks of steam pipes are used; one covers the lower end and the other the upper end of the blancher. Excess steam escapes through a chimney over the exit chute.

Steam consumption in this type of blancher is high but wastage can be reduced by careful temperature control, by keeping the entry chute sealed, by lagging the steam box, and by reducing the chimney draught to a minimum.

Filling

Most solid-pack apple is filled into No. 10 plain cans, which should be made from Type L tin plate to achieve satisfactory shelf life.

Blanched apple is filled into cans with scoops, and is tamped down at least twice during filling to ensure that the required fill-in weight is obtained and to eliminate air pockets in the pack. The can is filled until the apple projects about ⅛ in. above the flange and is then closed without delay.

Normally the apple is filled at 170-180 °F in order to ensure a good vacuum and a high initial centre temperature which assists in subsequent processing. When the apple is de-gassed before blanching, lower filling temperatures can be used.

Industry has recently adopted the practice of adding a small quantity of boiled hot water (200 °F) to the pack. For export, the weight of water must not exceed 5 per cent. of the total fill-in weight.

In addition to the economic gain the added water improves the quality of the pack. For example, it decreases the headspace volume of the can and hence the incidence of panelling and screwing in the cooling cans, and reduces product shrinkage and the drying out of the headspace surface.

There are several ways by which water may be added to the can. The most satisfactory is to fill it into the can before the apple is added. The water then tends to rise between the pieces of apple as the can is filled and displaces air from the pack. Other methods include injecting the water into the filled apple with a perforated needle or forcing a hole into the filled apple with a tapered wooden spike and measuring the water into the hole. Both these methods are likely to produce a wet area in the pack which may persist for long periods.

Processing

No. 10 cans are processed for 8-10 minutes in boiling water immediately after closing. This process is designed to sterilize the can and material near the can walls and depends on the fill-in temperature of the apple to sterilize the bulk of the pack.

Two main types of processing units are used: Draper belt cookers and rotary reel cookers, both types operating at atmospheric pressure. The reel cooker is preferred for economy in steam and space requirements.

Cooling

Experiments have shown that a No. 10 can of solid-pack apple requires approximately 2½ hours in water at 60 °F to reduce the centre temperature from 180 °F to 100 °F. Since it is not practicable commercially to cool this product completely, most canneries cool the cans for 10 to 20 minutes in water, and then air cool in open stacks. Although the rate of cooling is slower in stacks than in water, "stack burn" is rarely encountered in the industry.

Warehousing

After incubation (10-14 days), faulty cans are sorted by visual observation (swollen cans) or by tapping. Flip vacuum tests on cans segregated by tapping will distinguish between cans with satisfactory and negligible vacuums. The flip vacuum tester which was introduced to the industry by C.S.I.R.O. is now in use in three plants.

CANNED APPLE PULP

Both peeled and unpeeled apples, as well as cores and skins from the solid-pack line and occasionally from other sources, are used in pulp manufacture. The best product, however, is made from properly prepared Granny Smith, Cleopatra, French Crab, or Cox apples.

Process

The raw material is coarsely diced and subjected to a "hot break" in copper jam pans or stainless steel tanks fitted with mechanical stirrers. After breaking, it is sieved through ⅛-in. screens, then reheated and filled into No. 10 or four-gallon cans by either gravity-flow or piston-type fillers.

No. 10 cans are heat processed and cooled by the method used for cans of solid-pack, or they are inverted without further heat processing and cooled in open stacks. The four-gallon cans are inverted after soldering, and are cooled in open stacks or under water sprays.

Quality Defects

The use in this product of unpeeled apples and peel and core waste from the solid-pack line detracts from its quality. Skin pigments, especially from highly coloured varieties, discolour the pulp, and skin and core tissue is reported to impart some astringency and bitterness. In addition, because sprays such as lead arsenate and organic pesticides are used on the fruit, it is not desirable to use skin tissue in the manufacture of pulp.

CANNED SLICED APPLE IN SYRUP

This pack is produced in small quantities from high-quality fruit. The most suitable varieties are Cox and Sturmer.

The apples are peeled, cored, and trimmed by the methods used for solid-pack apple, then sliced in a "mandarin" slicer. After slicing, segments fall into a brine bath where some of the chaff (seeds, core fragments, and small pieces of apple) separates from the slices. The remaining chaff is removed by spray-washing the segments on inclined rotary ½-in. mesh wire screens.

The slices are steam blanched for a few minutes at 180-200 °F. Usually 9-10 ounces of apple are filled into each 1-lb Tall plain can using an automatic multi-pocket filler, and boiling syrup (30-35 °Brix) is added. The cans are exhausted in steam to a centre temperature above 160 °F, closed, and processed for 10 minutes (still cook) or 6 minutes (rotary cook) at 205-210 °F. The cans are then water-cooled for 10 minutes before warehousing.

TECHNICAL PROBLEMS

As a result of their survey the authors have come to the conclusion that the most pressing technical needs of the industry are:

- The development of methods for increasing the yield from apples, for example by the utilization of skins, cores, and the considerable quantity of soluble solids which goes to waste in the blancher effluent.
- New machinery and techniques should be developed for the continuous production of apple pulp and for peeling small fruit for pulp manufacture.

No investigation of the effect of any treatment on an animal carcass is complete without assessing in some way the eating quality of the meat after treatment.

Sensory Tests of

AS PART OF THE COOPERATIVE STUDIES ON frozen beef carried out by C.S.I.R.O. and the British D.S.I.R. at the Meat Investigations Laboratory of C.S.I.R.O. at Cannon Hill, Q., it was necessary to develop a method for measuring quantitatively various attributes of the meat, such as colour, texture, and flavour, which affect the reaction of the consumer.

The basic features of schemes for the subjective appraisal of the eating quality of meat have been discussed in reports by Dawson and Harris (1951) and the Advisory Board on Quartermaster Research and Development (1954). In this article it is intended to describe the method which has been used at Cannon Hill and to comment on points of interest which have arisen in the course of its development.

PREPARATION OF MEAT FOR TASTING

The aim of the sensory tests was to determine the eating quality of selected samples of meat under conditions which permitted valid conclusions to be drawn but which were as close as possible to normal conditions of eating. Consequently, it was felt desirable to work with both roasts and grills.

It may be assumed that the effect of cooking methods on the eating quality, especially when confined to dry cooking, will be determined by the history of temperature and moisture changes in the sample during cooking. Thus there will be less variation in any particular sample if a method of cooking is selected in which temperature gradients are small in as much of the meat as possible. Reasonable uniformity of cooking, within a particular roast and between different roasts, will be more likely to occur with joints of a standardized shape and size, such as rolled roasts prepared from boned-out meat, than with typical domestic roasts consisting of meat-on-bone, which may be irregular in shape, size, and composition. After considering the cuts available a cylinder of meat 4 in. in diameter and $3\frac{1}{2}$ in. long was selected as the standard size for a roast. For cuts in which large muscle sections were available with relatively small amounts of fat, the roast was prepared by trimming down the appropriate section leaving the required muscle region in the middle. For sections such as ribs, the excess intermuscular fat was removed after boning and the appropriate muscle (normally the eye muscle) rolled in sufficient of the other lean portions to give a rolled roast of appropriate diameter. It was then skewered, and cut to the correct length. Roasts were thus obtained which did not vary markedly in weight or in rate of cooking.

To determine the best conditions for uniformity of cooking, time-temperature curves were obtained at a number of points within roasts when lying on their sides and when on their ends. The temperature distributions were quite different for the two positions. In roasts cooked on their sides, the slowest heating point was near the centre and the temperature increased more or less uniformly outwards, as would be expected if the rate of heating was the same through all surfaces. In roasts cooked on end, however, the slowest heating point was

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the Quality of Meat

well above the centre. This was evidently due to the much higher rate of heating of the bottom surface than of the other surfaces, owing to good contact with the metal tray over most of the bottom surface. In both positions there was a large proportion of the volume of the roast near the middle in which temperatures were fairly uniform, so that there was little to choose between them as regards uniformity of cooking. As the roast was distorted less by cooking on end, however, this was adopted as the standard position.

An oven was chosen which showed the least internal variation of temperature. It was fitted with a thermostat with a vacuum switch with the bare thermostat located at a point close to where the samples of meat were to be cooked.

For roasts, an oven temperature of 350 °F was selected and under control this temperature was normally maintained within 5 °F. In practice, they were cooked in pairs, each in a stainless steel tray on the same level in the oven, one on each side of the thermostat. A thermocouple was located at the centre of each roast and the roast was removed when the centre temperature reached 180 °F. Below this temperature some tasters could detect a raw flavour in the meat. Under the above conditions roasting took about 140 minutes, the two roasts usually being removed within a few minutes of each other. Sometimes the thermocouples indicated that the roasts were cooking at different rates. This could generally be corrected by interchanging the positions of the roasts about half-way through the cooking period.

To prepare a grill under standardized conditions the steaks were cut immediately before cooking to a standard thickness of $\frac{3}{4}$ in., and roasted (usually in pairs) on a wire grid in a stainless steel tray with the oven temperature set at 550 °F. By this means the grills were cooked on both sides without turning, and the flavour and appearance were the same as with an ordinary grill. The oven temperature was raised to 550 °F before commencing and when the grill was placed in the oven, full heat was turned on. The temperature returned to the control point in about 20 minutes. Each grill had a thermocouple located as near as possible to the middle and was removed from the oven at a temperature of 180 °F, which was reached in about 25 minutes. Care had to be taken that the thermocouple did not become exposed owing to splitting of the grill.

PRESENTATION OF SAMPLES FOR APPRAISAL

Grills were presented for appraisal hot as $\frac{1}{2}$ in. by $\frac{1}{2}$ in. sections through the full thickness of the grill.

As evidence from the Low Temperature Research Station, Cambridge, and the British Ministry of Food (private communications) had indicated that roasts were more accurately assessed cold, all samples of roasts were allowed to cool, usually by holding overnight in a cold room, before being presented to the taster. Samples were in the form of small pieces from slices $\frac{1}{8}$ in. thick cut at right angles to the central axis of the roast and taken from near the centre.

SENSORY APPRAISAL

The primary aim of the tests was to determine the effect on eating quality of various treatments without necessarily determining the reaction of any particular section of the consuming public. In the terminology of Hicks (1948), an "analytical" assessment was made rather than a determination of "consumer reaction".

It was considered that the following attributes of eating quality of lean meat needed consideration: odour (natural and foreign), flavour (natural and foreign), tenderness, juiciness, and colour.

SENSORY SCALES

To permit each attribute to be assessed in a comparable manner a scale of intensity was drawn up for each. In each scale five points were defined by appropriate description and four intermediate points were added. A similar scale was prepared for overall acceptability, constituting an approximate consumer's preference rating applicable to the group of tasters used.

The scales as defined for each of the attributes are given in the table below.

In practice, tasters were presented with printed copies of the scales, together with coded samples, and they marked the code letters for each of the attributes at the appropriate points on the scales. With experience, most tasters considered they could use the scale with a further subdivision between each of the nine points shown, and use of the seventeen-point scale was encouraged.

Tasters felt they could not taste more than six samples at one session without some loss of discrimination and that they performed best when relatively hungry.

CONSTITUTION OF PANEL AND RELIABILITY OF TASTERS

Before a panel was set up, all members of the staff of the laboratory, both technical and non-technical, were tested for taste thresholds for salt, acid, bitter, and sweet. The variation in threshold acuity was small but consistent. Thresholds for salt, acid, and sweet varied only twofold, while those for bitter varied tenfold. The more acute members were almost invariably the younger ones and included both smokers and non-smokers. Threshold values for solutions of meat extract showed much the same relative

Scales for Scoring Various Attributes of the Eating Quality of Meat

Score	Odour		Flavour		Tenderness	Juiciness	Colour	Acceptability
	Natural	Foreign	Natural	Foreign				
0	None	None	None	None	Very tough	Very dry	Very light	In preference to normal
1	—	—	—	—	—	—	—	—
2	Slight	Slight	Slight	Slight	Tough	Dry	Light	Equal to normal
3	—	—	—	—	—	—	—	—
4	Moderate	Moderate	Moderate	Moderate	Slightly tough	Slightly dry	Normal	In absence of others
5	—	—	—	—	—	—	—	—
6	Strong	Strong	Strong	Strong	Tender	Juicy	Dark	Only when very hungry
7	—	—	—	—	—	—	—	—
8	Very strong	Very strong	Very strong	Very strong	Very tender	Very juicy	Very dark	Nauseating

acuity among the tasters though the variations were greater and the results less consistent. Finally, tests were made of ability to detect admixtures of strongly flavoured mince with weak-flavoured mince; it was found that there was little variation in this ability. The absence of any relation between threshold acuity and discriminatory ability has frequently been mentioned in the literature. In view of this, and the fact that it is practically impossible to make corresponding tests for such attributes as tenderness and juiciness, all available members of the staff were accepted on the panel. Subsequently the results of certain members were discarded for one or more attributes if examination of the data indicated their results were inconsistent with respect to that attribute or that they were insensitive to it.

All panel members were then given a period of training in which a series of minces of different flavour intensities were presented to them and agreement was reached in open discussion as to the location of the sample on the flavour intensity scale. To test the effectiveness of the training, five bulk samples of mince, in which the flavour ranged by approximately equal steps from full flavour to almost tasteless, were prepared by mixing the full- and weak-flavoured materials. Bulk samples were held in storage at 15 °F and portions of each were presented as hot cooked mince to the panel on four separate days covering a period of about one week. On each occasion an additional sample was included to prevent the panel merely ranking the samples and giving them memorized scores. Tasters selected the samples for tasting in random order. The divisions of the scales were given numerical ratings from 0 to 8 as in the table on the previous page.

Preliminary examination showed that the majority of the figures for any sample lay either on the mode or one point either side of it. This appeared to be satisfactory, but further study revealed that even this slight scatter indicated real differences in the interpretation of the scale. This is confirmed by the analysis shown in the following table. Differences in scoring by the tasters were highly significant and could be readily illustrated by plotting individual scores against mean panel scores.

From examination of these results it was evident that when significant taster and sample differences were present, a significant S × T interaction would be expected but the ranking of the samples would not be altered. The existence of a D × T interaction is to be noted; this indicates that even after intensive training the scaling had not been completely stabilized.

Analysis of Variance of Tasting Tests of Flavour Intensity in Beef

Source of Variance	Degrees of Freedom	Variance	F
Samples	4	289·983	505***
Days	3	0·335	—
S × D	12	0·545	—
Tasters	11	8·223	14·14***
S × T	44	1·411	2·47***
D × T	33	1·080	1·89**
S × D × T	132	0·573	—

** Significant at 1 in 1000 level.

*** Significant at 1 in 100 level.

With roast and grilled meat, for which it is practically impossible to set up control samples, the difficulty of standardizing the tasters' conceptions of the sensory scales became even more apparent. In exploratory trials with material which was expected to vary because of such treatments as tenderizing, analysis disclosed that, in addition to the expected treatment effects, there were significant taster differences and interaction between tasters and treatments. The interaction might, as indicated above, arise from variations in the tasters' interpretations of the sensory scale. This is confirmed by the fact that seldom was the direction of the effect of any significantly effective treatment reversed by any member of the panel and the regression between the scores of individuals and the panel means were all reasonably linear and positive.

It was, therefore, considered a sounder procedure to accept different but reasonably stable interpretations of the sensory scales by members of the panel than to make an

ineffective attempt to have each member adopt a fixed interpretation which might differ from his normal conception. With each taster using his own scale it would be expected that the individual scores would be more consistent than when the taster endeavoured to conform to a strictly defined scale. This implies the possibility of day-to-day variations in the individual's scale but such variations should not be all in the same direction and their effect on the panel mean should not be large.

Attendance of all members of the panel at all sessions, although desirable, was not possible. To cover the few occasions when a member was unavoidably absent or missed a sample, it was considered adequate to estimate the taster's probable score from prepared regression diagrams relating his score for a particular attribute to the panel mean for that attribute. These diagrams were used to check variations with time in the reliability and sensitivity of the tasters.

As it is virtually impossible to make valid duplicates of samples of grilled and roasted meat, the final assessment of the success of a particular sensory appraisal scheme cannot be made by studying agreement between replicates, but only by examining the results for consistency. Studies of the variability due to panel errors and to the material have shown that it is desirable to carry out all major comparisons on the one day, and where possible to make these comparisons on the two sides of a single carcass. Under these conditions, if the samples are taken from about a dozen pairs of sides, the differences in mean scores, which can be shown to be statistically significant, are of the order of one scale unit or less—a degree of precision likely to be adequate for most work.

While the same principles apply for the scales of foreign odour and flavour as for the other attributes, much greater variability in sensitivity was evident for these attributes. One or two members of the panel consistently gave moderate to high scores to samples which the remainder of the panel claimed were free from foreign flavours and odours. For these attributes it was all the more important that panel membership should always be complete, as taster variability was as important as sample variability.

The scheme outlined above was designed for appraisal of the eating quality of lean tissue. The same principles have also been applied when tasting fatty tissue. The appropriate portions of fatty tissue were made into a rolled roast by wrapping in lean tissue and cooking as for a normal rolled roast. It was found that even when a taster had a revulsion from fat he was still able to score for the presence of foreign flavours and odours. No other attributes were studied.

CONCLUSION

The above comments are primarily intended to describe the setting up of the sensory appraisal scheme used in the co-operative investigations at the C.S.I.R.O. Meat Investigations Laboratory. The scheme was devised to assess differences in selected attributes of eating quality in beef due to various treatments applied to the animal carcass.

Reference has been made to statistical treatment of the results to indicate the success of the scheme, but in doing so nothing is implied as to the statistical validity of handling discrete sensory scores by statistical analysis or as to the normality, additivity, or homogeneity of the data obtained. Such matters will be discussed where necessary in papers giving data obtained by the use of the above technique, which will be published elsewhere.

ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance given by Mr. J. A. Robinson, who made all cooking tests and measurements of temperature distributions in joints, and Mr. P. E. Bouton, who did much of the statistical work.

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Cooperative investigations into problems associated with frozen beef have been under way for some time at the Meat Investigations Laboratory, C.S.I.R.O., Brisbane, and the Low Temperature Research Station, D.S.I.R., Cambridge, England.

The Measurement of Drip from Frozen Meat

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ONE IMPORTANT PROBLEM PECULIAR TO FROZEN meat is the phenomenon of "drip", namely the tendency for cut muscle surfaces to exude a reddish viscous liquid when thawing, making the meat appear less attractive than when fresh or chilled. From the beginning of these investigations it was necessary to establish reliable techniques for measuring the amount of exudation and to determine how it is affected by the particular methods employed and by the environmental conditions during measurement.

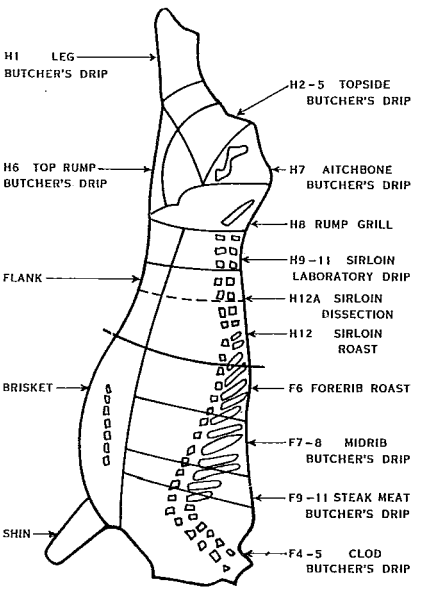
QUARTER DRIP AND BUTCHER'S DRIP

In normal commercial practice, carcasses are chilled as sides, quartered, and then frozen. After storage they are thawed out as quarters and then broken down into butchers' cuts, in which form they are held until cut to retail requirements. In the cooperative investigations, measurements of drip were made as follows:

Quarter drip was defined as the loss in weight of a quarter when taken directly from frozen storage and held for 48 hours in a thawing room with the temperature maintained at 50 °F. Weighings, made with a steelyard, were measured to the nearest ounce and the drip expressed as ounces per 100 lb of quarter.

Butcher's drip was defined as the loss in weight of the butchers' cuts obtained by breaking up the thawed quarters according to the scheme outlined in the figure opposite and holding them in the thawing room at 50 °F for a further 24 hours. It was recorded for each cut or as an overall figure for a quarter or side as required. Weighings were made to $\frac{1}{16}$ oz and the drip again expressed as ounces per 100 lb original weight.

It should be realized that both these measures are arbitrary, since the temperature of the thawing room, the period between weighings, and the method of cutting are



Side of beef showing cuts used in experiments and purpose for which each cut was used.

fixed arbitrarily. While these conditions are probably fairly representative of trade practice, some important factors remain uncontrolled. During the period of thawing as quarters and holding as butcher's cuts, the weight changes of the meat will be due in part to exudation of fluid from the thawed-out meat and in part to condensation and absorption on the cold and partially desiccated surfaces.

Consequently the measured values of quarter drip and butcher's drip will be affected to some extent by the humidity of the air in the thawing room. In the room used for the tests, and in those used commercially, this humidity is not controlled and is influenced by the conditions outside to an extent which will vary from room to room.

It is also expected that the temperature history of the meat will play a part in determining the extent of exudation. In a room in which the air temperature is controlled the rate of warming of the beef is still influenced significantly by the rates of air flow over its surface.

Departures from the standard method of breaking up will also influence the extent of exudation. If a large cut such as the top side, or one of the rib cuts, is subdivided into smaller cuts, the total amount of fluid obtained is increased and is largely determined by the area of cut muscle surface. Consequently, the drip, when expressed as the ratio of the weight loss to the original weight, will depend on the surface area to weight relationships in the particular cuts under examination.

Thus, although an attempt has been made to fix the conditions under which quarter drip and butcher's drip are measured, this has not been successful. In making use of these measures it is important to ensure that such uncontrolled conditions do not affect any comparisons of drip it is hoped to make. In fact, the only really reliable comparisons are between measurements made on samples held near each other in the same room at the same time.

LABORATORY DRIP

Recognition of these objections to the use of quarter and butcher's drip led to the search for a measure which would be independent of experimental conditions and preferably one which could be applied to small pieces of meat. Measurement of the loss of weight from a small excised sample of meat held in a suitable container under suitable conditions was suggested. For such a method the main factors which would affect the measured amount of drip are:

- The amount and distribution of non-muscle tissue in the sample.
- The air temperatures and rate of heat transfer to the sample.
- The nature of the container.
- The dimensions of the sample and its orientation with respect to muscle structure.
- The time which elapses between cutting the sample and measuring the drip.
- The way in which the sample is held and exposed within the container.

These factors will be discussed in order before describing the procedure adopted for measuring "laboratory drip".

It is generally accepted that drip is a property of the proteinaceous muscular tissue in which moisture is normally held bound to the protein. It is believed to be caused by a decrease in this binding capacity. Since fatty tissue contains relatively little water and there is no evidence that this is held other than mechanically, it was considered desirable to express drip as the percentage weight loss on a fat-free basis. Even when thus expressed, however, the results for samples comparable in all other respects generally show a negative correlation with fat content and this must be borne in mind in comparing results.

The air temperature in the room was again selected arbitrarily at 50 °F and the room was controlled at this temperature.

Although small samples of meat in small containers approach room temperature rapidly, the way in which they do so is still affected to some extent by their position and orientation in the container. It was, therefore, necessary to ensure that these did not vary.

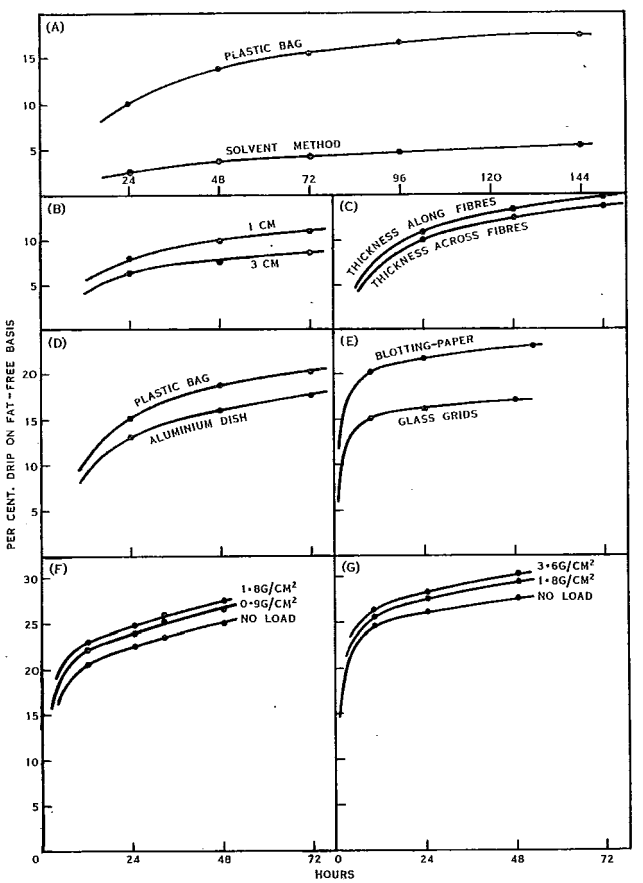
The meat sample is placed in a container to prevent losses by evaporation and to eliminate the influence of the humidity of the outside air on weight loss. Any container which can be hermetically sealed could therefore be used, but one made of thin metal has

been found most suitable since it is robust and permits rapid heat transfer to the sample.

It has been found that the amount of drip from small samples is greater when the shortest dimension of the sample (i.e. its thickness) is along the fibres of the muscle than when it is across them. Drip, expressed as a percentage of the original weight, decreased when the thickness of the sample was increased from 1 cm to 2 cm or from 2 cm to 3 cm, although the change was not always statistically significant in the former case. Only a little information is available on the effect of the surface area of the sample, but it is consistent with an increase in percentage weight loss with increase of surface to volume ratio.

The manner in which exudation from muscle samples varies with time is shown in the figure below, from which it is seen that there is a rapid release of fluid over the first 24 hours and a slow and fairly constant release thereafter. Consequently a standard period of exposure, considerably greater than 24 hours, seemed necessary to obtain reliable results, and tests have shown a period of 48 hours to be satisfactory.

Experiment has shown that the method of exposing the samples within the container has a definite effect on the result. When the samples were hung vertically in plastic bags as originally suggested by Empey (1933), the drip was greater than when they were laid horizontally. Samples placed on a grid above the bottom of the container showed greater drip than samples on the bottom in contact with exuded fluid. The drip was increased by placing a weight on top of the samples, and markedly so when the samples were placed on a pad of blotting-paper. All these effects are consistent with the drip being increased by increase in hydrostatic pressure. Typical examples of these differences are illustrated below.



The effects of various factors on drip.

Each experimental point represents the mean of at least four samples. Unless otherwise stated, each sample was 6 cm by 3 cm by 1 cm, the smallest dimension being along the direction of the fibres. The curves in any one figure are for contiguous samples from the same piece of muscle.

A, *Comparison of samples in plastic bag and in "solvent".*

B, *Comparison of samples 1 cm and 3 cm thick exposed in plastic bags.*

C, *Comparison of samples with the thickness along and across the direction of the fibres; samples exposed in plastic bags.*

D, *Comparison of samples exposed in plastic bags and on glass grids in aluminium dishes.*

E, *Comparison of samples exposed on blotting-paper and on glass grids, both in aluminium dishes.*

F *and* G, *Influence of loading; samples on blotting-paper in aluminium dishes.*

PROCEDURE

With the above considerations in mind, the technique described below has been evolved for the determination of "laboratory drip".

Samples are prepared from the appropriate sites in the frozen carcasses. They are cut by means of a band saw or other suitable tool into blocks measuring 6 cm by 3 cm by 1 cm, the shortest dimension being along the direction of the muscle fibre. Normally at least four such samples are prepared from a given site in a carcass. After "sawdust" and snow have been removed from the surface of the samples, they are placed in tared aluminium dishes approximately 3 in. in diameter and $\frac{3}{4}$ in. deep, with well-fitting lids. In each tared container there is a glass grid which serves to keep the sample out of contact with the exuded fluid. The samples are placed in the containers, which are weighed immediately, sealed with scotch tape, and placed in a well-exposed situation in a constant temperature room held at 50 °F. After 48 hours, the containers are opened and the samples, after any fluid adhering to the surface has been removed by light dabbing with blotting-paper, are transferred to a fresh tared container and weighed. The samples are then used for determination of fat content and for any other analytical work deemed necessary. The results are finally expressed as percentage loss on a fat-free basis.

COMPARISON WITH OTHER TECHNIQUES

The effects of minor modifications of technique have already been considered but it is also of interest to compare the technique finally adopted with those in use elsewhere.

Figure (*A*) on p. 33 shows the results obtained with the so-called "solvent" method of Kaloyereas (1947). It is seen that his method gives much lower values and there is no indication, even after a lapse of several hours, that a constant figure will be reached.

Data are available for comparing the present method with two versions of the method used at the Low Temperature Research Station, Cambridge, and referred to as Hale I and Hale II respectively. The essential features of these are:

Hale I.—Samples are 3 in. by 1 in. by $\frac{1}{4}$ in. with the $\frac{1}{4}$ in. measured along the muscle fibre. The samples are placed on their broad faces on the bottom of a 4-in. Petri dish with loose-fitting lid and with one edge of the Petri dish raised $\frac{1}{2}$ in., the long axis of the samples being at right angles to the line of greatest slope. Loss of weight is determined as change in weight of the sample after removing excess moisture by dabbing with blotting-paper, and is expressed as percentage loss on a fat-free basis.

Hale II.—The samples are treated similarly but the weight change is determined as the gain in weight of the Petri dishes due to the exuded fluid.

Data for two muscles from each of 20 sides are available for comparing the Hale I method with that used at Cannon Hill; and data for two muscles from each of 12 sides for comparing the Hale II method with the Cannon Hill technique. The mean values for drip are:

Sides 1-20		Sides 21-32	
Cannon Hill	6·79	Cannon Hill	8·04
Hale I	7·32	Hale II	5·80

In both cases the differences are highly significant ($P < 0{\cdot}001$). The high value for Hale I presumably indicates some evaporation from the upper surface of the samples, and possibly some effect due to the sloping dishes. As indicated by the insignificance of interactions with sides and muscles, the difference between the methods is largely independent of the magnitude of drip. The low value for Hale II may be accounted for by the retention of moisture on the samples and evaporation from the exuded fluid in the dish. The latter effect could vary with external humidity, and there is a suggestion in the figures that the difference between the methods does vary from time to time. The reproducibility of the various methods, indicated by the error terms in an analysis of the results, was much the same for all three.

It is apparent that there is little to choose at least between the Cannon Hill and the Hale I methods, but the results illustrate that the measurement of drip is at present purely an arbitrary technique depending, among other things, on size of sample and the method of removing moisture. It is, therefore, very important that standard conditions and procedures be laid down for each method.

RELATION BETWEEN MEASURES OF DRIP

Many data are available in which measurements of quarter, butcher's, and laboratory drip have been obtained from the same carcasses, and attempts have been made to obtain a relationship between these measures. It has not been possible to find any correlation between laboratory drip and the other measures, nor can variations in the latter be explained in terms of changes in laboratory drip.

With small samples, as in laboratory drip, the weight or volume of the sample has the greatest effect, but in the larger cuts the area of exposed muscle becomes increasingly important. It is therefore suggested that two factors are involved, one being the potential supply of fluid and the other the resistance to the movement of fluid. The first is presumably dominant in the determination of laboratory drip and the second in drip from butchers' cuts. Although the butcher is more immediately interested in the magnitude of drip from large cuts, it is suggested that "laboratory drip", which is a relatively precise measurement, should be retained as a measure of the change in water-holding capacity, or analogous physical properties, of the muscles brought about by various treatments applied to the carcass.

ACKNOWLEDGMENTS

The author gratefully acknowledges assistance given by the staff at the Cannon Hill Laboratory, particularly Mr. N. T. Russell, who did many of the weighings and fat determinations, and Mr. P. E. Bouton, who carried out other parts of the work, including most of the statistical treatment of the results. Thanks are due to Dr. R. A. Lawrie for permission to use data on the Hale methods.

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International Congress on Canned Foods

THE THIRD INTERNATIONAL CONGRESS ON Canned Foods will be held from September 24 to 28, 1956, in Rome, and on September 29 and 30 in Parma, where the congress members will visit the Eleventh Canned Food and Packaging Fair and attend a conference on machinery and equipment for the canning industries.

It is being organized by the International Permanent Committee on Canned Foods for the purpose of promoting the advance of scientific, technical, and practical knowledge useful to the canned food industry, and developing public interest in canned foods.

The Committee holds sessions every year during which specialized working commissions meet. These are: the scientific commission, divided into five groups, bacteriology, methods of analysis, nutrition, legislation, packaging; commissions for the standardization of cans; for regulation and definition of canned vegetables, tomatoes, fruit, fish, meat; for the study of vegetable and fruit growing for the canning industry; on information and statistics; on machinery and equipment, etc.

The C.I.P.C. enjoys consultative status in the Economic and Social Council of the United Nations, special consultative status in the United Nations Food and Agriculture Organization, and has been admitted to cooperate with other international governmental and non-governmental organizations: International Organization for Standardization, World Health Organization, International Union of Pure and Applied Chemistry, etc.

In addition to its ordinary activities, the C.I.P.C. carries out the organization of international congresses on canned foods.

Further information can be obtained from the Comité International Permanent de la Conserve, 3, rue de Logelbach, Paris 17e, which makes available to all concerned a special booklet containing a registration form. The fee for membership of the Congress has been fixed at 6000 Italian lire.

Estimation of Chloride in Foods

A Rapid Potentiometric Method

By K. W. Anderson

The Nicholas Institute, Sherbrooke, Vic., formerly of the Division of Food Preservation and Transport, C.S.I.R.O., Hobart, Tas.

THE CONTROL OF THE CONCENTRATION OF salt (sodium chloride) in foods is of considerable interest to processors. Certain levels must be reached in cured foods such as bacon, ham, and salt fish in order to control microbial spoilage, and in many products the salt concentration has a critical level necessary for optimum palatability.

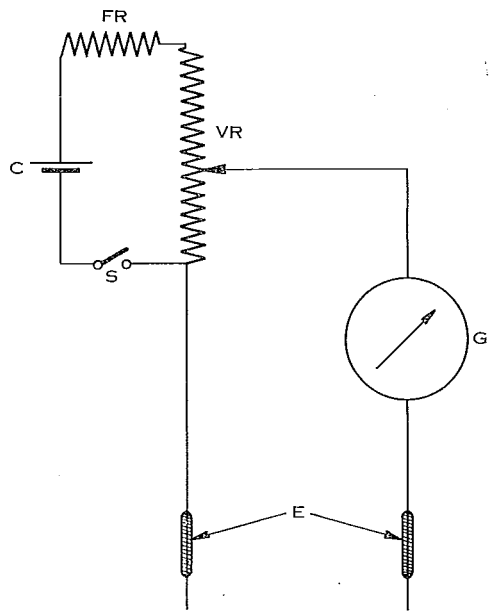
Chemical methods for the estimation of chloride ion in foodstuffs are all dependent primarily upon the removal of interfering protein by techniques involving ashing in the presence of calcium or magnesium acetate, or digestion with nitric acid, or by selective extraction of chloride with solvents or protein-precipitating agents, followed by titration of the protein-free chloride solution according to the classical methods of Mohr or Volhardt, as described by Scott and Furman (1939).

Ingram and Hawthorne (1945) sought to obviate this time-consuming separation by titrating the chloride in aqueous extracts and suspensions of meat of such dilution that interference by protein was reduced to a minimum. The end point of their silver nitrate titration was potentiometrically determined with a sensitive, but somewhat ungainly, silver/silver chloride reference half-cell electrode system. Recently Samson (1953) briefly described a much simpler electrode system consisting of two silver wires which were electrolytically coated with silver chloride and functioned independently of any reference half-cell.

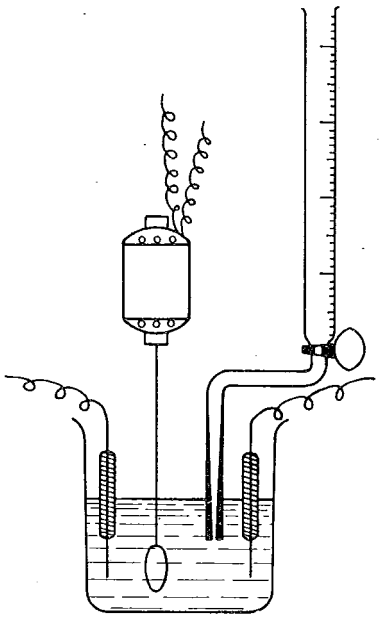
The application of this electrometric titration technique has been studied in detail in the Tasmanian Regional Laboratory of C.S.I.R.O., and salt analyses on a range of fish and some meat products have been compared with data obtained from the same material by ashing and Mohr titration.

MATERIALS AND METHODS

Preparation of Electrodes.—Two silver wires (approximately 20 S.W.G.) were insulated with suitable material, leaving about one inch of metal exposed at one end, and insulated leads of copper wire were fused to the other end. Several methods of coating the silver wire with silver chloride were tried. The most satisfactory is illustrated on this page. A 5·0 per cent. solution of silver chloride in 10M ammonium hydroxide is



Apparatus for coating the electrodes.
C, 1·5-*volt dry cell;* FR, 4000-*ohm radio-type fixed resistance;* VR, 0-1500-*ohm radio-type variable resistance;* G, *sensitive galvanometer;* E, *electrodes;* S, *switch.*



The titration apparatus.

electrolysed for a few hours using a 1·5-volt dry cell with the silver wires as the anode and a carbon rod as the cathode. Voltages in excess of 1·5 gave more rapid coating but the silver chloride was apparently less firmly deposited, for after a short period of use the electrodes lost their efficiency. The electrodes tended to "tire" if 12 or more estimations were carried out in a short time; they generally recovered if left in distilled water for an hour or so, but in any case could always be regenerated by recoating. The electrodes were rinsed and stored in water when not in use. They were not handled unnecessarily, as even gentle abrasion soon removed the coating.

Galvanometer.—The galvanometer employed was constructed by J. L. William, Melbourne, and was of the moving spot type with a coil resistance of 40 ohms, a critical resistance of 90 ohms, and a sensitivity of 25 mm per microampere. Other galvanometers of similar sensitivity could be used equally well.

Titration Apparatus.—The titration apparatus, illustrated on this page, consisted of a 50-ml beaker containing the chloride solution into which dipped the two insulated electrodes, a 5-ml microburette containing the silver nitrate titrant, and a stirrer. The microstirrer was driven from a small electric motor of the type used to drive model trains (for example Electroton Type 240, Rev Motors Ltd., Bolton, England, which may be run off a 3-volt cell).

Procedure.—The sample was macerated with water (approx. 80 ml) in the microbowl of a Waring Blendor and the suspension boiled briefly to promote coagulation of protein. It was then cooled and made up with water to a volume of 100 ml. The protein was separated by filtering, centrifuging, or merely being allowed to settle, and an aliquot containing 2-20 mg NaCl was transferred to the titrating vessel along with 30-40 ml distilled water.

A small potential difference was applied across the electrodes by closing the switch and current flow was adjusted by means of the variable resistance until the galvanometer showed full-scale deflection. The stirrer was switched on, and 0·08M $AgNO_3$ run in from the microburette. Some experience was necessary to determine the optimum rate of addition concomitant with the damping characteristics of the galvanometer and the effectiveness of the stirrer in restoring equilibrium.

The current was limited by the chloride concentration so that it decreased during the titration until it reached a minimum at the end point. The first excess silver ions caused a fresh current to flow and this was indicated sharply by the galvanometer. Calculations are then made using the relation: 1 ml 0·08M $AgNO_3 = 4·68$ mg NaCl.

Recovery of Added Salt in Homogenates of Canned Fish

Material	Salt Percentage			
	Initial	Added	Theoretical	Found
Australian salmon	3·54	1·25	4·79	4·83
Herring in tomato sauce	1·80	5·00	6·80	6·92
Anchovy paste	9·85	5·00	14·85	15·08
Oyster liquors	0·60	10·00	10·60	10·71

RESULTS

Highly consistent results were obtained with the method; analyses of 10 replicate samples each weighing two grams, from a homogeneous mass of canned fish, did not differ by more than ±2 per cent. from the mean figure. Results obtained in a trial of the method are given in the table on p. 37. Homogenates of various canned fish were analysed before and after the addition of known quantities of salt. The figures, which show the recovery in each case, demonstrate that the method can be applied in the laboratory without introducing gross inaccuracies.

In another test the method was compared with ashing. Salt was estimated in a number of fish and meat products by the potentiometric method and by the conventional procedure of ashing in the presence of magnesium acetate and titrating with silver nitrate. A comparison of the results appears in the table at right, where again the new method is seen to compare favourably with the old.

Salt Concentrations of Fish and Meat as Determined by Ashing and Mohr Titration and by the Potentiometric Method

Material	Salt Percentage	
	Ashing and Mohr Titration	Potentiometric Method
Sodium chloride solution	0·523	0·538
Canned barracouta	1·89	1·92
Anchovy paste	9·97	9·85
Canned salmon	3·34	3·54
Herring in tomato sauce	1·74	1·80
Crayfish (raw)	1·03	1·06
Bacon (lean meat)	8·10	8·21
Beef steak (raw)	0·175	0·172
Prepared sausage meat (1)	0·335	0·340
Prepared sausage meat (2)	1·67	1·80

CONCLUSION

Samson's method was found to be capable of estimating chloride ion in fish and meat products after a brief semi-quantitative separation of protein, and the results compared favourably with those obtained by the more tedious ashing procedure. The apparatus is simple and robust: in the C.S.I.R.O. Tasmanian Regional Laboratory it has required virtually no maintenance for 12 months. An estimation by the new method can be completed in 15 minutes.

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Antibiotics in Food Preservation

IN A RECENT ARTICLE IN THIS JOURNAL W. J. Scott (1956)* explained why the United States Food and Drug Administration did not permit the addition of antibiotics to human foods.

Since the article was published, the U.S. Administration has approved the use of a special food grade of the antibiotic aureomycin (chlorotetracycline) for the preservation of certain foodstuffs. Initially it will be used only on poultry of high quality, which has been processed under strictly hygienic conditions. The antibiotic must be applied by dipping, not by injection, and its concentration in any portion of the uncooked flesh must not exceed 7 parts per million.

Approval to treat poultry with aureomycin by dipping was granted only after proof had been obtained that the antibiotic was completely destroyed by normal cooking. So far as other foodstuffs are concerned, the Administration, for the present, holds to the view it expressed in 1953, that the direct or indirect addition of antibiotic drugs to foods for human consumption constitutes a hazard to public health.

* Scott, W. J. (1956).—Antibiotics in food preservation. *C.S.I.R.O. Food Pres. Quart.* **16**: 5-6.

NEWS from the Division of Food Preservation and Transport

MATHEMATICAL STATISTICS AND FOOD RESEARCH

It is the practice in C.S.I.R.O. for the Division of Mathematical Statistics, the headquarters of which are in Adelaide, to place members of its staff with other Divisions throughout the Commonwealth. In the Division of Food Preservation and Transport at Homebush, for example, there are three Research Officers and three Technical Assistants.

The Research Officers of the Division of Mathematical Statistics enter into many investigations on food preservation. They study experiments bearing on these investigations and hold discussions with the officers carrying them out. When the experimental work involves the collection and reduction of numerical data, the experimenter and the statistician confer and agree on a design for the experiment. The problems most commonly requiring statistical treatment are those associated with biological materials, namely, fruit, vegetables, meat, fish, and eggs.

In the final stage of an experiment, foods are often subjected to organoleptic tests. These are carried out under the supervision of a dietitian, but the statisticians help to design the tests, and carry out the statistical analysis of the results. The cooperation of the statisticians is essential in these tests, for both the test materials and the assessments of the judges may vary considerably.

In addition to cooperating in the research on food preservation, the statisticians carry out research on the subject of mathematical statistics. An investigation relating to the statistical analysis of rating scores has been completed recently.

The Technical Assistants of the Division of Mathematical Statistics, who are trained in the procedures of statistics and in computing with desk calculators, assist the Research Officers with the statistical analysis of the experimental data.

PERSONAL

Dr. HARLAN K. PRATT, ASSISTANT PROFESSOR of Vegetable Crops in the University of California at Davis, who is travelling as a Fulbright Scholar, arrived in Sydney on March 29 to spend nine months of his sabbatical leave as a guest worker with the Division. Dr. Pratt's special interest is the post-harvest physiology of vegetable crops. In Australia he will spend much time with the plant physiologists and biochemists of the Division's Plant Physiology Unit, but he will also make observations on the storage, transport, and marketing of fruit and vegetables.

Dr. S. I. HONDA, a graduate of the University of Wisconsin, U.S.A., who has been associated with the Division's Plant Physiology Unit at the University of Sydney since September 1953, leaves Australia early in July. Dr. Honda first worked at the Plant Physiology Unit as a Fulbright Scholar, and joined the research staff of C.S.I.R.O. in October 1954. In conjunction with Dr. R. N. Robertson he has made valuable contributions to a study of the role of mitochondria in the uptake of ions by plant cells.

PUBLICATIONS BY STAFF

SOME PROBLEMS OF SPOILAGE IN CANNED FOODS. *J. F. Kefford and W. G. Murrell. Food Tech. Aust. 7: 491-8, 545-9 (1955).*

From 1950 to 1955, 60 cases of spoilage in canned foods were investigated by the Division of Food Preservation and Transport. This paper, first presented at the Fifth Convention, Institute of Food Technologists, Australian Regional Sections, May 1955, describes microbial spoilage due to underprocessing or to post-processing contamination, and the following types of non-microbial spoilage: hydrogen swells and other corrosion problems, nitrite swells, carbon dioxide swells, discoloration, and tainting. The diagnostic methods are outlined.

FACTORS IN CANNED HAM CONTROLLING CL. BOTULINUM AND STAPH. AUREUS. *W. J. Scott. Ann. Inst. Pasteur, Lille 7: 68-73 (1955).*

As the texture and flavour of ham would be impaired by long retorting at high temperatures, canned hams are pasteurized rather than sterilized. The heat treatment may be expected to destroy all or almost all non-sporing organisms present but has little or no lethal effect on bacterial spores in the centre of the can.

Both *Cl. botulinum* and *S. aureus* do at times grow and produce their toxins in canned hams. In this paper, contributed to the First International Symposium on Food Microbiology, the author considers the various factors which may affect the growth of these organisms in the can: pH, nitrite, nitrate, and sodium chloride, and finds that none of these alone is likely to prevent their growth. The concentration of sodium chloride in hams is considered in relation to the activity of the water, and it is shown that water activity in two hams was about 0·004 lower than the value deduced from the concentration of sodium chloride in the water phase. It is concluded that canned hams should be stored at temperatures low enough to prevent the growth of organisms not destroyed by the heat process.

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WATER-SOLUBLE CONSTITUENTS OF FRUIT. V. SUGARS AND POLYOLS OF THE APRICOT FRUIT. *A. S. F. Ash and T. M. Reynolds. Aust. J. Chem. 8: 444-50 (1955).*

The sugars and polyols of the apricot fruit were separated by chromatography on columns of charcoal and cellulose followed, where necessary, by paper chromatography. Glucose and sorbitol were separated by chemical methods. Xylose, fructose, glucose, sucrose, sorbitol, and *meso*inositol were characterized, xylose as the dibenzylidene dimethylacetal, fructose as the 2, 5-dichlorophenylhydrazone, glucose as the diethylmercaptal, sucrose as the octa-acetate, and sorbitol and *meso*inositol as the hexa-acetates. A number of apricot oligosaccharides composed of glucose and fructose units were separated by chromatography on charcoal and on paper.

PHYSIOLOGY OF PEA FRUITS. II. SOLUBLE NITROGENOUS CONSTITUENT IN THE DEVELOPING FRUIT. *H. S. McKee, Lydia Nestel, and R. N. Robertson. Aust. J. Biol. Sci. 8: 467-75 (1955).*

Soluble nitrogenous compounds in the seeds and hulls of developing fruits of the pea (*Pisum sativum* var. Canner's Perfection) were studied at successive stages of growth during two seasons. Of the 26 compounds studied, some were undetectable in some samples and all decreased in the seeds during the period of intense protein synthesis. The results are discussed in conjunction with those of other workers.

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THE WATER RELATIONS OF GROWTH AND RESPIRATION OF SALMONELLA ORANIENBURG AT 30 °C. *J. H. B. Christian. Aust. J. Biol. Sci. 8: 490-7 (1955).*

The influence of water activity (a_w) on growth, respiration, and Na and K content of cells during respiration has been studied for *Salmonella oranienburg*. Sucrose, glucose, glycerol, NaCl, and KCl were added to control a_w. The organism grew in a glucose-inorganic salts medium at 0·97 a_w when any of these solutes was used to adjust a_w, but at 0·96 a_w only when glycerol was employed. Respiration was not inhibited in glycerol-adjusted solutions at a_w's at which the rate was very low in other solutes. When a_w was controlled by sucrose or glucose, cells oxidizing glucose accumulated K but not Na. Accumulation of K was greatest at 0·975 a_w. In solutions of NaCl accumulation of K was small and in glycerol solutions it was absent. The differences between glycerol and the other solutes tested are discussed.

Copies of the papers mentioned above may be obtained from the Librarian, Division of Food Preservation and Transport, Private Bag, P.O., Homebush, N.S.W. (Telephone: UM 8431, UM 6782.)